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ABSTRACT

This paper is based on the on-going research, work, and teaching carried out in the Mathematics Foundations Course (MFC) at Goldsmiths College, University of London. Teaching is a very intimate and rewarding experience for the mathematics lecturer as well as for the adult student. Mathematics lecturers and adults should be challenged by their experiences, and adult students of mathematics in particular should be empowered and rewarded for their efforts. Focus is placed on "Comparative Mathematics" education and teaching received from the perspectives of adult students' views about themselves as well as their views on the teachers who teach them. It is argued that much of the debate about adults' access to and performance in higher education concerns Humanities and Social Science students. Mathematics, despite its importance as an essential pre-requisite for studying science and technology, has been absent from the discussion. In their study, students reached conclusions about how adults see their own mathematical backgrounds, recorded and celebrated some of their achievements, and indicated some grounds for optimism about how likely they are to achieve in the field. They made suggestions about how adult learners of mathematics might best be prepared to make decisions about the suitability of mathematics courses for them. Students believe that this is a basis for some important practical conclusions for practitioners advising and supporting adult students. This study looked at a group of adults' return to Re-Learning Mathematics with the hope of gaining access to the BSc Mathematics and Statistics degree Course at Goldsmiths College, University of London. The paper concludes, by selecting three major theories that have some bearing on the selection of content and how it is taught, and characterizes these contexts as essentialism, encyclopedism, and pragmatism to include the general position in order to identify constituent curriculum theory. (Contains 36 references.) (Author/ASK)

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VIEWS ON ADULTS RE-LEARNING MATHEMATICS: A COMPARATIVE STUDY

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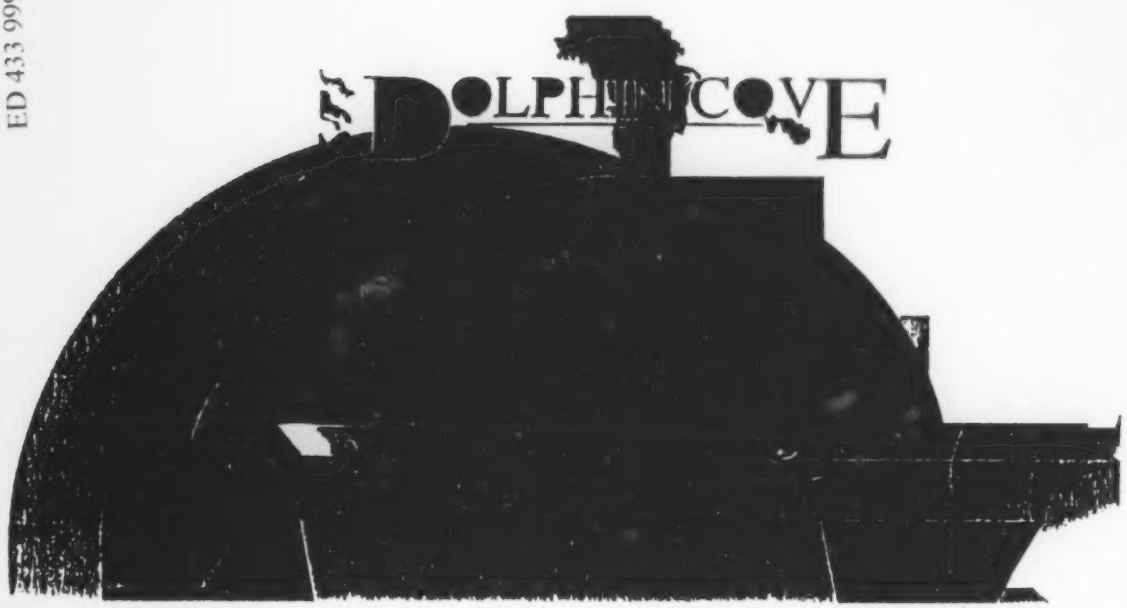

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PAPER PRESENTED AT THE ADULTS LEARNING MATHEMATICS - 5th CONFERENCE
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VIEWS ON ADULTS RE-LEARNING MATHEMATICS: A COMPARATIVE STUDY

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Abstract:

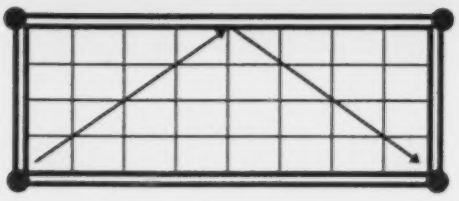
`Views on Adults Re-Learning Mathematics: A Comparative Study', is based on the on-going research work and teaching carried out for the last 8 years of the Mathematics Foundations Course (MFC),at Goldsmiths College University of London, was reported at ALM-1 in Birmingham (Angiama, RO, 1994a), ALM-2 in Exeter (Angiama, RO, 1995b),ALM-3 in Brighton (Angiama, RO,1996C), ALM-4 in Ireland (Angiama, RO,1997d), and ALM-5 in Netherland (Angiama,RO, 1998e).

Teaching is a very intimate and rewarding experience for the Mathematics Lecturer as well as for the adult student. Mathematics Lecturers and adults should be challenged by their experiences, adult students of mathematics in particular, should be empowered and rewarded for their efforts. The Paper focuses on `Comparative Mathematics' education and teaching received from the perspectives of adult students' views about themselves as well as their views on the teachers who teach them. Richard Crucher et al (1997),have argued that `much of the debate about adults' access to, and performance, in higher education has concerned Humanities and Social Science Students. Mathematics, despite its importance as an essential pre-requiste for studying Science and technology has been absent from the discussion. In their study, they reached conclusions about how adults see their own mathematical backgrounds, record and celebrated some of their achievements, and indicated some grounds for optimism about how likely they are to achieve in the field. They made suggestions about how adult learners of mathematics might best be prepared to take decisions about the suitability of mathematics courses for them, which probably have wider relevance which they believe is a basis for some quite important practical conclusions for practitioners, advising and supporting adult students: 'Re-Learning Mathematics' (my emphasis).

My study looked at a group of adults' return to Re-Learning Mathematics with the hope of gaining access to the BSc Mathematics and Statistics degree Course at Goldsmiths College University of London, in either Mathematical Studies, Mathematics and Statistics, or Mathematical Studies with Computer Science . The Course provides a real opportunity for adult students Re-Learning Mathematics and it provides them also with progression as a stepping stone to awaken those areas of their mathematical knowledge. Mathematics as part of European lifelong Learning for adult students has the implication that most adults have a wealth of experience but they have an attention span of 20 minutes and hence using a variety of activities, like tutorials, and effective teaching methods in place can help facilitate Re-Learning Mathematics possible.

Why do so many people (Angiama, RO, 1994a, 1995b, Frankenstein et al 1989,M.D. Schmitt 1995),have problems with mathematics? How can teachers of mathematics, help adult students deal with mathematics anxiety? What is Mathematics? How do teachers of mathematics transform instructional practice to better serve adult learners needs? How can a teacher of mathematics facilitate our adult students' from passive learners to active agents of their mathematical learning process? Will learning about statistics and probability enable our adult students to view their world more critically and encourage them to ask more questions? What are the most effective ways for adults to acquire important mathematical skills and abilities? Are educational problems heightened in the areas where adults live and work? What are the educational concomitants of social justice within the nation state for adults learning mathematics? How can equality of educational opportunity be realised in the face of poverty, poor housing and unequal educational provision be responsible to its environmental context for adults?

These are some of the questions important in this paper and invites the participants attending the 5th Adults Learning Mathematics -A Research Forum (ALM-RF 5), Conference their views of what they think whether these questions constitute a basis towards a critical mathematical curriculum, for the mathematics of today's adults. The Paper concludes, by selecting three major theories which have some bearing on the selection of content and how it is taught. I characterise these contexts as `essentialism, enclyclopedism and pramatism to include the general position in order to identify constituent curriculum theory for Adults Learning Mathematics (ALM)



Start

INTRODUCTION

Among Comparative and Adult Educationists the possibilities of contributing to the planned curriculum development of adults mathematics education and the quality of education have always informed debate in recent years. Our ability to define the quality of mathematics education for our adult students depends upon the extent to which it is possible to draw a distinction between what is education and what is not education and on the basis of such distinction to make statements has been made it is then desirable to draw distinctions between what is 'good' mathematics education and what is 'better' or 'worse' mathematics education for our adult students with different needs, interests, circumstances, work, social and domestic commitments (Diana Coben, ALM 1997). Given this we should then be able to say what constitutes improvement in the quality of mathematics education for our adult students here in the UK and elsewhere in the world.

Certainly, I have argued (Angiama, RO, 1994a), that over the last decades in Africa, Asia, Europe, South America and North America, a certain revolution has occurred in adults Learning Mathematics (ALM) and in particular, the concept of 'Adults in Community Education', as a process whereby human populations adjust their environment in the nation state. For a start (Saunders, P. 1981), theoretical orthodoxies of mathematics educators have been challenged and the application of both social and curriculum theories to the analysis of cities have given rise to new questions (see Abstract), about the role of the urban system in capitalists economies in Europe and elsewhere in which fierce competition have led naturally to one form of human organisation by forcing increased functional and spatial differentiation thereby creating utilitarian ties of natural interdependence. Thus, the development of "Adults Learning Mathematics - A Research Forum", is such a 'revolution'. ALM is an international research forum bringing together researchers and practitioners in adult mathematics/numeracy teaching and learning of mathematics by adults.

Richard Crucher et al (1997), have argued that 'much of the debate about adults' access to, and performance, in higher education has concerned Humanities and Social Sciences Studies. Mathematics despite its importance as an essential pre-requisite for studying Science and technology

has been absent from the discussion. In their study, they reached conclusions about how adults see their own mathematical backgrounds, record and celebrated some of their achievements, and indicated some grounds for optimism about how likely they are to achieve in the field. They made suggestions about how adult learners of mathematics might best be prepared to take decisions about the suitability of mathematics courses for them, which probably have wider relevance which they believe is a basis for some quite important practical conclusions for practitioners, advising and supporting adult students' 'Re-Learning Mathematics' (my emphasis).

MATHEMATICS & MATHEMATICS FOUNDATIONS COURSE

Mathematics is a cumulative subject and the analogy of constructing a house is appropriate here. My research into adults and young people Re-Learning Mathematics shows quite clearly that if the foundation of the house is weak, the resulting structure is bound to be shaky. A good foundation coupled with a good method of teaching mathematics in place will surely produce good results. It is, therefore, appropriate to mention the 'Mathematics Foundations Course' (MFC), that I teach at Goldsmiths' College, University of London which started in 1990 (Angiama, RO, 1990, 1992).

THE STUDENTS

The background to this study looked at a group of adult students as well as young people drawn from across a broad section of the world in a city, and across mixes of boundary cultures, return to Re-Learning Mathematics, with the hope of gaining access to BSc (Hons) Mathematics and Statistics degree course at Goldsmiths' College, University of London, in either Mathematical Studies, Mathematics and Statistics, Mathematics and Psychology or Mathematics Studies with Computer Science. The MFC provides a real opportunity for adults and young people 'Re-Learning Mathematics' and it provides them also with progression routes as a stepping stone to awaken those areas of their hidden mathematical knowledge. Mathematics as part of 'European Lifelong Learning' for adult students has the implication that most adults have a wealth of life experiences but research evidence suggests that they have an attention span of 20 minutes and hence using a variety of activities, like tutorials, counselling and effective teaching methods in place can help facilitate Re-Learning Mathematics possible.

HOW HAVE I DONE IT?

Let us consider the Practitioner as a researcher. The focus in this comparative study was the development of modules of unit booklets and the value for adult students is greatly enhanced which included an element of student self-assessment including a self-diagnosis of strengths and weaknesses. As such, such self-assessment by students of their own learning has been found to be very effective and each unit has its explicit aims and objectives, outlining the knowledge, communicating mathematics skills, developing skills in mathematical reasoning and the processes inherent in the unit and these are shared with the students who have been asked to complete an exercise at the end of most pages for their assessment.

The unit scheme also offers the possibility of negotiating between the course co-ordinator and students on certain key issues, such as the method of teaching and learning of mathematics. The development of mathematical understanding and confidence building can often be best fostered through student centred learning approaches supported by appropriate teaching and learning materials. Teaching and learning mathematics should also recognise the range of prior experience and learning which adult students can bring to the Mathematics Foundations Course in order to build confidence.

Summarising, I argue that Mathematics studies relationships and calculations arising from quantity, shape, statistical information and time. Nonetheless it is a practical activity with inference logic, and not merely a theoretical study. Although mathematics has enormous power to solve practical problems, it is still regarded, justifiably, as an abstract subject.

Yet 'Mathematics' is a cumulative subject and it is like when building a house, if the foundation is very weak then, it follows that the structure is bound to collapse. I also argue that a good mathematics foundation course with a good teaching method in place is sure to produce good results, and we can be sure to turn out many good mathematicians to meet the needs of our challenging and ever increasing demands of the schooling system and the demands of the technological world:

> "Mathematics is the basis of all new technologies because algorithms are the basis of software and materialised mathematical logic is the basis of hardware for computers and microprocessors. Mathematical theories and models are becoming increasingly important as the basis of a variety of forward-looking alternatives in stimulating planning and knowledge in economic and technical fields, for example, in control, optimisation, and construction, or in the fields of politics or social science through the use or misuse of statistics. Mathematics has long been established as the scientific core of the natural sciences and, increasingly, of the Social Sciences as well (MaaB & Schloeglmann 1988, p295)."

The great acceleration of technological development here in the UK and around the world since the Second World War has shown no sign of abating, rather increasing with the world in a city (Giddens, A. 1990 p63, Back 1996), and the demands of the future are tremendous. Anthony Giddens has pointed out modernity is 'inherently globalising'. In our current information age new technologies like the internet and the fax machine make it possible for us sitting here in London to bounce messages around the globe and access information from archives in places as remote as India, Brazil and North America. Yet, teaching methods of teaching mathematics remain very much one of teaching particular techniques formally, for example in mathematical investigations, audio-visual demonstrations and practice on the computers.

THE LEARNING PROGRAMME COVERS THE FOLLOWING TOPICS:

Number Recognition
Binary Numerals
Co-ordinate Geometry
Study skills-Essay (1)
Mathematical Investigations(l)
Bearings, Maps and Journeys
Percentage, Ratio and Fractions
Mathematical Investigations (2)
Similar and Congruent triangles
Number Review
Study skills-Essay (2)."
Basic Concept of Vectors
Straight Line Graphs
Discovering Rules
The Standard Form
Set Theory
Using Formulas
Inequalities
Co-ordinates
Study Skills (3)
The Straight Line
Graphs
Negative Numbers
Solving Equations
Sketching a Graph
Algebra Review
Functions
Binomial Expansion
Exponential Function
Study Skills-Essay (4)
Surds
Trigonometry 1 (definitions and Graphs)
Trigonometry 2 (Identities)
Index Numbers
Shape and Space Review
Rates of Growth
Sequences (Arithmetic and Geometric Progress
Logarithms (Definitions and Tables)
Laws of Indices
Probability and Statistics (1)
Probability and Statistic (2)
Sample and Statistics
Data Handling Review
Regression and Correlation
Calculus - Differentiation and Integration
Difference Equation-An application
Complex Numbers
Trigonometry 3 (Tables)
Conics
Review and Consolidation of all the topics & examinations

While these units correspond to a 30 week programme, the programme is flexible in that it may be adopted in the light of student needs and the time taken for regular revision sessions throughout the year including tutorials.

DELIVERY AND COHERENCE

The Programme of Learning is presented and delivered as an 'all-through' experience of been as a teacher of mathematics for over twenty years. The learner, therefore, experiences a coherent programme of mathematics studies. In this phase of the study I, carried out interviews with some of the adult students to develop their feeling with mathematical thinking before they started the Mathematics Foundations Course.

> "A well structured Course which enable Adults Like us to re-enter into the study of Mathematics I have always believed I would benefit from the course, and I have. Not having studied Mathematics for 13 years, the Course has enabled me to relearn a number of vital skills, concepts and knowledge. I thoroughly enjoyed the entire course. The units on binary system, calculus and Indices were a real bonus. I have in particular acquired a better knowledge of the laws of indices, standard forms and inequalities. Thus on the whole, the course has been very interesting and stimulating and well informed. The Lecturer Mr Angiama has been very helpful, kind, patient, caring, respectful, sensitive to students' needs, enthusiastic and encouraging. He has put in a great deal of hard work into all units and sessions he has taught. He raises students' self esteem and is determined they should succeed with his positive leadership". Far (1996-1997)

The practitioner as a researcher recognises, however, that learner confidence is as crucially important as coherence, thus an appropriate balance is sought, in terms of learning strategies, between the acquisition of mathematical knowledge, and problem solving as specific:

- recognise patterns and structures in a variety of situations and form generalisations
- analyse a problem and select a suitable strategy applying an appropriate technique in problem solving
- apply combinations of mathematical techniques and skills in problem solving
- Make logical deductions from given mathematical data and undertake extended pieces of course work.

Roseanne Benn (1997,P.25), has argued that 'the use of group work encourages problem generation and solving approaches to learning mathematics. Group work encourages the exploring and discovering of mathematics in a concrete and human process, Through discussion, adults can learn to articulate their point of view, listen to others, ask appropriate questions, how to recognise and respond to mathematically relevant challenges and in these ways to develop their mathematical conceptions and their applications' . Within the programme of the Mathematics Foundations Course, pair and group work are integral to the delivery of the learning programme in addition to the taught sessions throughout the year.

ASSESSMENT METHODOLOGY OF THE PROGRAMME

My intention is to offer a broad introduction in identifying 'assessment methodology of the learning programme, by which the MFC experienced with access courses'. Cummins (1994, p4) has asserted that 'assessment is now the most significant issue confronting the basic education sector'. Increased funding means that adequate documentation of adult students progress must occur, and yet in some countries teachers in this sector, like teachers in other sectors, are inadequately prepared to address contemporary assessment issues (Bishop, A. et al 1996).

In some ways, this might be judged as a suitable preparation for adult students Re-Learning Mathematics for Lifelong Learning, while at the same time, providing them experiences which will enable them to tackle mathematics confidently and effectively. The Learning Programme units as above has been linked to the assessment objectives of the learning outcomes and should enable the following to be achieved and thus recognise the importance of identifying and building on a student's potential for development both in knowledge and understanding:

- Assessing the development of mathematical knowledge and oral, written and practical skills in a manner which encourages confidence and a positive attitude towards mathematics.
- Assessing the ability to read mathematics, write, and talk about mathematics in a variety of ways.
- Assessing the development of a feel for numbers, the ability to carry out calculations and to understand the significance of the results obtained.
- Assessing the ability to apply mathematics to everyday situations and develop an understanding of the part which mathematics plays in the world around them.
- Assessing the development of mathematical principles.
- Assessing the ability to identify and interpret relevant factors in a situation which may be represented mathematically and, where necessary, to select an appropriate method to solve the problem.
- Assessing the ability to communicate mathematically with clear expression and the development of abilities to reason logically, to classify, to select, to generalise and to prove.
- Assessing the appreciation of patterns and relations in mathematics, and the development of mathematical abilities by consideration of problems and conducting individual and co-operative enquiries, including extended pieces of work and assessing the appreciation of patterns and relationships in mathematics.

Katherine Safford (1998, p222), said of 'Assessment', that 'students know it is 'the test' that really matters'. Adults Re-Learning Mathematics on the Mathematics Foundations Course will provide evidence of their achievement by regular assignments which included completed work away from the class and class work on problem-solving exercises, project work and written examinations. The criteria for assessment of the assignment is set at the appropriate level for the award of credits.

MODELS AND TECHNIQUES IN COMPARATIVE EDUCATION

The paper now focuses on 'Comparative Mathematics' education and teaching received from the perspectives of adult students about themselves as well as their views on the teachers who taught them. Considerable attention is paid in the literature of the philosophy of mathematics education (Thom 1973, p204, Hersh 1979, Steiner, H.G. 1987, Cooney, T.J. 1998, Thompson, A.G. 1984 p125, Ernest, P. 1989c, 1995 p9, Angiama, R.O. 1996). Other articulations stress both that teaching approaches in mathematics incorporate assumptions about the nature of mathematics education, and that any philosophy of mathematics has classroom consequences.

Empirical research has confirmed claims that "teachers' views, beliefs and preferences about mathematics do influence their instructional practice". Here Paul Ernest of Exeter University, has argued forcefully that 'any philosophy of mathematics education (my emphasis), has many educational and pedagogical consequences when embodied in teachers' beliefs, curriculum developments, or examination systems. Equally, he has also argued that 'teachers' personal philosophies of mathematics, understood as part of their overall epistemological and ethical framework on their espoused conceptions of teaching and learning mathematics. These in turn, subject to the constraints and opportunities of the social context of practice, give rise to the realised theories of learning mathematics, teaching mathematics, and the related use of mathematical texts and curriculum materials in the classroom (Ernest, 199c) and such a model is partially validated by empirical work'.

Clearly, clarity does not philosophically ensure consensus and when cross-cultural comparisons (see Brian Holmes, 1974-1975), of quality of mathematics education are attempted the difficulties of reaching agreement among philosophers of mathematics education become so much greater. It can be argued that it is conceivable that on a world-wide basis a

measure of agreement might be reached that what goes on in some classroom is 'mathematics education' for adults re-learning mathematics, while what goes on in other classrooms is 'not mathematics education' for adult students. Serious differences of judgement are likely to reveal themselves when attempts are made on the same world-wide basis to differentiate between good, better and worse mathematics, can create the need for unambiguous definitions which can be translated without ambiguity into other languages. One of OECDs concerns is to establish indicators which will permit the quality of mathematics education for our adult students to be compared and measured. What follows is an attempt to see the issues in relation to cross-cultural comparison of quality of mathematics education and in relation to normative statements about knowledge, man and society.

MATHEMATICS FROM MANY CULTURES OF THE WORLD

We begin the 'Comparative Study of adult students' attitudes to Mathematics learning from many cultures of the world'. Janet Duffin and Adrian Simpson in their paper (1995 p99), have argued that 'those who work with adults learning mathematics must have had the experiences of feeling that some of the difficulties students can reveal about their earlier learning of the subject might be better understood if we could get 'inside' of their personal thinking about the mathematical processes which cause them difficulty'.

Adult student 'WO', comes from Togo in West Africa and who is Western educated African scholar from the colonial 'master'. However, in spite of his acquired Western veneer, 'WO' has not completely estranged from his roots and there is a tendency for him to be ambivalent. There is too, in his attitudes to mathematics education, a real need for African people to truly rediscover themselves as the originals and cultural heritages. It can refer to everything people as a result of their being in a society, for example, the very precise concept of number recognition in Ewe which is one of the languages of people living in South of Benin, Togo and Ghana (West Africa, see map, fig ROA/1).

Bassey Andah (1988), has argued that 'talk of sense making systems' suggests two interpretations of "understanding". In the first place, one understands when one is able to explain or make the foreign system 'coherent' from the observer's standpoint and context. In the second sense, one understands the native system of counting numbers and the mathematical operations in Ewe language (my emphasis), when one perceives their acts and their meaning as performer does. There

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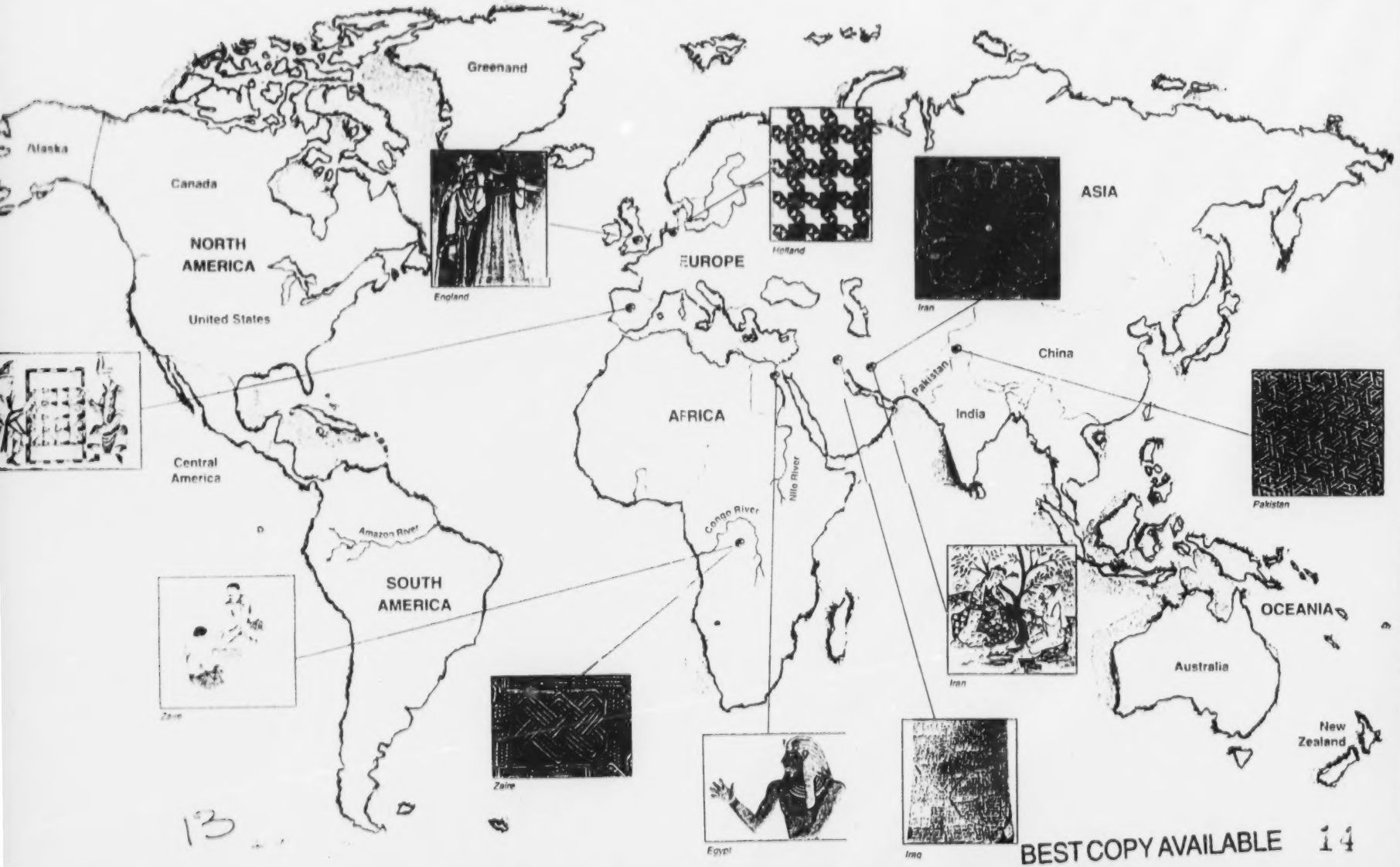
MATHEMATICS FROM MANY CULTURES



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is thus a meaning which follows from an initial assumption of consistency in the native's application of his/her symbolic performances in a formal, logical sense with each other'. This means identifying myths about themselves and dispelling them, eschewing the element of self-ethics, and rediscovering their religion including technology.

Mathematics apart, numbers necessary for everyday life are, for most students, a real headache. I was no exception when I was a student 40 years ago. But today, I would not hesitate to say that I am a mathematician of sorts, inasmuch as I can deal with the basic concepts in mathematics. To understand my progress in this fearful subject called mathematics, it is important to know who I am, where I have been, where I am now and where I am going. The end will be a conclusion.

Being native of colonial Africa, Mathematics were for me, as for most Africans of the same age, a mystic subject. Not because we Africans did not like mathematics or could not understand it, but because of the nature of the colonial education system, which did everything to prevent colonised subjects from doing mathematics. Proof of this assertion is that the colonial administration has always given more materials and help for Social Sciences [1] study than for technical learning. For example, Sociology, Politics, Philosophy, Languages books were given free to the pupils in basic education [2], while Mathematics and other technical books had to be bought. And even for the people who had money, Mathematics books were rarely available in book shops.

That is the education situation in which I was involved and what has been said so far says much about who I am, because to know who you are, you have to remember where you come from whatever your new situation is.

Today, a retrospective look at Africa allows me to understand clearly the fact that the Coloniser - whoever it was (British, German, French) - did not have any interest in making Mathematicians out of African people despite the omnipresence of Mathematics in the numerous African Languages [3]

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[1] Sociology, Politics, Philosophy, Literature, European History and Languages, Theology, Psychology, Geography .....

[2] Primary, Secondary and College

[3] Even, Post-Colonial Governments, which are managing the pseudo independent States of Africa, are doing nothing to help scientific development of the Continent, because they remain dramatically subdued by the ancient Colonisers.

As an example of this omnipresence of Mathematics in African cultures, I may refer to the very precise concept of number recognition in Ewe[4] my mother tongue, which is one of the derived languages of Yoruba[5]. If I am referring to numbers, that is because they are the starting point of any mathematical approach, how else is it possible to understand Mathematics?

Thus in Ewe, any 8 year old child must know the following counting system:

gbalo	=	zero	woaden	=	sixteen
deka	=	one	woadren	=	seventeen
eve	=	two	woenyi	=	eighteen
etor	=	three	woasieke	=	nineteen
ene	=	four	blave	=	twenty
aton	=	five	blator	=	thirty
aden	=	six	blane	=	forty
adren	=	seven	blaaton	=	fifty
enyi	=	eight	blaaden	=	sixty
sieke	=	nine	blaadren	=	seventy
ewo	=	ten	blaanyi	=	eighty
woedeka	=	eleven	blaasieke	=	ninety
woeve	=	twelve	alafa	=	hundred
woetor	=	thirteen	akpe	=	thousand
wene	=	fourteen	akpeakpe	=	billion
woaton	=	fifteen			

There are also in Ewe the four basic 'mathematical operations as follows:

ta	=	add
Ke	=	subtract
dji	=	multiply
ma	=	divide

I would like someone to tell me one-day, how someone who manipulates such concepts could not understand modern mathematics.

This is just a parenthesis to bring out the evidence of the natural predisposition of Africans to Mathematics, and also to show where I have been from the beginning in relation to learning mathematics. In brief, I was mistakenly directed towards Social Sciences Study despite my ability in mathematics. Perhaps, the Head Teacher felt that it was the only way to help me to reach Europe. Once in France, I achieved a Master's degree in Social Science. But, as I could not find a job with my "Maitrise" of "Aminstration Economique et Sociale", I re-learnt Mathematics and Computing from the beginning to Master's degree standard. "Maitrise" of "Informatique", which

[4] Ewe is the language of people living in the South of Benin, Togo and Ghana (West Africa).
[5] Yoruba is one of the most widely spoken languages in Africa. Originally the inhabitants and founders of the Oyo Kingdom, the Yoruba people (more than 60 million) are today essentially localised in South Nigeria (West Africa) with an important Diaspora spread throughout the whole African Continent.

allowed me to work in France as an I.T. Engineer from 1979 to 1993. I then went back to Tongo, my country of origin in West Africa, where I taught - at "Universite du Benin" - Anthropologie" and "Mathematiques appliquees aux Sciences Sociales". Social Sciences students need to familiarise themselves with number recognition, Number Sets, Sets and Graph Concepts, Functions, Differentiation and Integration.

Back in France at the end of 1994, I could not find a suitable job, due to the economic recession within the I.T. industry. I then came to the United Kingdom in 1996 and learnt English from October 1996 to July 1997. In the academic year 19970-1998, in order to improve my English and also to review (recall) my mathematics skills, I have been doing a 'Mathematics Foundation course' at Godlsmiths' College, University of London, in the Department of Continuing and Community Education with R.O. Angiama, Lecturer, Mathematics in Continuing and Community Education.

Mr Angiama's teaching method is very successful and very helpful, provided that one really wants to learn Mathematics. For me, I am extremely satisfied to be spending my Saturday afternoons in his classroom.

As for where I am going, I could reply anywhere, destiny will lead me. And my reply is function of this equation: $\mathbf{y = mx + c/2}$, where

- y is different possible changes in life
- x is the effort to change things
- m is value of the influence of God on every one (1 = small, 2 = medium, 3 = big, -1 = death)
- c is value of energy you have depending on age (1 = + 50 years old, 2 = less 50, 3 = less 26)

$\mathbf{y = f(x) => f:x \dashrightarrow mx+c/2, x \in CR^{+}}$

In my case for example, if I give to x the value 10 corresponding to my will to change things, y could take any of the following values: -4, 6, 11, 16 as demonstrated below.

x = 10, m = 1, c = 2, then y = (-10 +2)/2 = -4

x = 10, m = 1, c = 2, then y = (10 +2)/2 = 6

x = 10, m = 2, c = 2, then y = (20 +2)/2 = 11

x = 10, m = 3, c = 2, then y = (30 +2)/2 = 16

Notice that one m = -1, it doesn't matter whatever the value of c is, because at that point you die.

This means I could respectively die (-4), continue Mathematics study next year (6), find a good job (11) or fall in to an excellent situation (winning the lottery for example) (16).

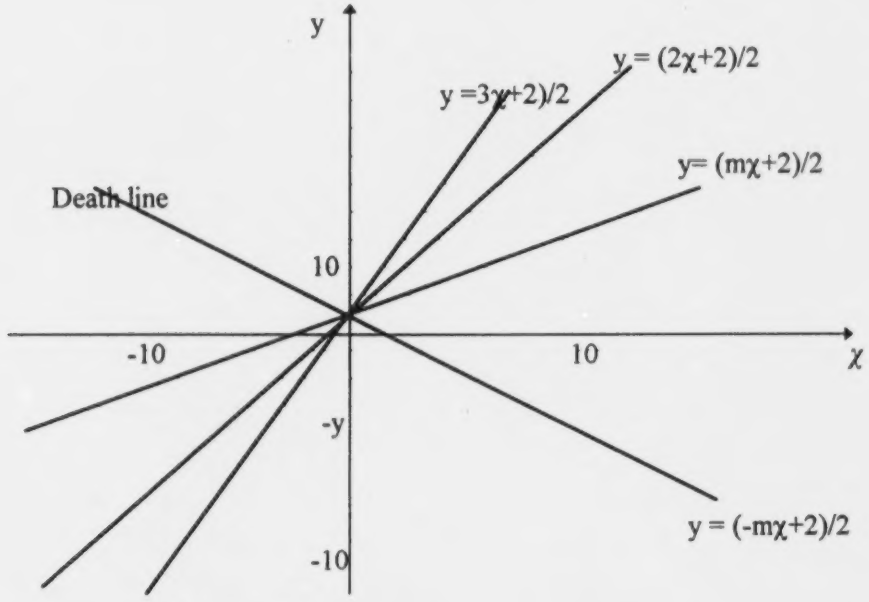
Notice also on the diagram below that "Silver Tea Cup"[6] equals no hope any more, where "Silver Tea Cup" means the follow:

Sine positive, Tangent and Cosine negative, or

Sine negative, Tangent positive, Cosine negative, or

Sine negative, Tangent negative, Cosine, Cosine positive.

Anyway, this is just a guess and its name is "Mathematics Speculation".



I may conclude what has been written so far by saying that the two goals which led me to enrol on the Mathematics Foundations course have been reached. First, I wanted a course where my academic skills would not be frustrated. Passing through Mr Angiama's Mathematics learning program has helped me to revive a good part of the Mathematics knowledge and skills buried in my subconscious. Secondly, by submitting more than 80% of Mathematics exercises to be checked by Mr Angiama, who never hesitates to correct my English beyond the pure mathematical aspect of my work. I have learnt some academic aspects of English that I would not find in an ordinary English class. I must recognise that mathematical investigations, which must be explained accurately, are a good way to learn English in England. The reason for this is because languages and Mathematics are irremediably connected, anyone who wants to study Mathematics must first learn the language in which they are taught.

[6] RO Trigonometry Unit 12

In the early days, the arithmetic that was taught was basic calculation, whose purpose was to provide a grounding in the rules of addition, subtraction, multiplication and division. The aim was to provide people with a working knowledge of simple money and other calculations which they found then in their everyday life. Changes in society brought about by increased industrial and commercial activity involved people in more complex mathematical calculations. Nevertheless the teaching method of teaching mathematics remained very much one of teaching particular techniques.

In the mid 20th Century many industrialists began to express concern about the lack of mathematical ability among young people who came to them from schools and colleges for employment. Whereas many of these young people were able to perform calculations on textbook problems, they were incapable of using their mathematical standards in an increasingly technological society, that a change was sought. New mathematics studies relationships and calculations arising from quantity, shape, statistical information and other sources. The emphasis has been put on knowing how to seek one's own solution to real problems. This change which is a twofold lead to mathematics education.

Adult student Enya came from Uganda in East Africa (See Fig ROA/2). This comparative study reflects on the student's attitudes to mathematics education over a period of time. In his early education, mid- and later education it looks at the effects of the changing approaches and attitudes by his different teachers and the society under the influence of the nature of teaching received. It also looks into the causes of his negative attitude towards mathematics education largely caused by teachers and his parents in their interactions with him at home. As far as possible, the study investigates the social, cultural and domestic problems prevailing, and consider that they could have had an impact on the 'attitude question'. The student in his considered opinion assumed that, the teachers in the various schools were professionally trained teachers and that the 'Changing attitudes', question has surely dependent on them and the Community at large. He hypothesised and concluded that 'his Changing attitudes' towards Mathematics education was partly caused by either bad or good teachers coupled with the attitudes of those he associated with.

It seems appropriate to mention here in 'Comparative study', Bruner's theory of instruction in which he suggested that the essential points for teachers to consider are the following:

FIG. R0A/2

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"Children's predisposition towards learning the way in which the knowledge to be learnt is structured, the sequence in which the knowledge should be presented, and the motivation and rewards provided". According to Piaget's Immutable Sequence of Development, I was in the concrete operational stage 7 - 12 years old), hence was being introduced to application of Logic to physical situations, real or imaginary. I didn't know what Mathematics was all about, although the teacher continued to name the subject in progress Mathematics. I was not told the importance of that subject I was being exposed to, perhaps I would have attached meaning to it. In her book, (1984), 'How Children Learn Mathematics', Pamela Liebeck says:

> Some people may enjoy Mathematics because it is useful. This is particularly true of children. So teachers must be constantly aware that although it's useful, it's appeal for children is based on their intellectual response. [7]

I also recall the procedures of the teaching process where the teacher talked for hours and only asked us to do numerous sums in our books at the end. In most cases I got the sums wrong, although I was attentive and look as if I was following. In deciding who should learn what, the capacity of the learner is very important'. Brighter people can learn things, less bright ones cannot learn, in general older children can learn more readily than young ones, the decline of ability with the adult years, depends upon what it is that is being learned. [8]

I also remember we were all put together in a class of about 40, all to learn at the same place and time, regardless of differences in ages and abilities. In addition, the teacher would start the lesson without any kind of motivation or drawing attention to the importance of the information to be taught. He would put a rule on the blackboard, explain it with an example (verbally) and then set us to work through several sums. Failing any of the given sums resulted in our being punished. The central role of the Mathematics teacher in my learning process, coupled with the anxiety I had of being punished for mistakes, I began to see why Mathematics was regarded by the overwhelming majority as difficult.

Hilgard, E.R. (1958 p60), commented that:

> "motivation that is too intense (especially pain, fear, anxiety), may be accompanied by distracting emotional states, so that excessive motivation may be less effective than moderate motivation for learning some kinds of tasks, especially those involving difficult discriminations. Also a motivated learner acquires what he or she learns more readily than one who is not motivated. The relevant motives including both general and specific ones". [9]

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[7] Pamela Liebeck, (1984 edition pp13), How Children Learn Mathematics, Cox & Wyman Ltd Reading.
[8] H.B. Griffths & A.G. Hanson (1974), Mathematics, Society & Curricula, Cambridge University Press, p81.
[9] Allgard, E.R. (1958) p60, 2nd edition), Theories of Learning.

The old Chinese proverb came true then, as quoted by the same writer.

> I hear I forget
> I see I remember
> I do I understand[10]

Although Mathematics has enormous power to solve practical mathematical problems, it is yet regarded justifiably as an abstract subject. A Mathematical calculation, or a formula such as e^2 equals -1, does not of itself demonstrate any practical relevance. Even 'two' is an abstract concept. You cannot understand 'two' until you have met many pairs (for example, a pair of wings), and abstracted what all pairs have in common.

My teacher then didn't have this line of abstraction in mind, and he continually kept me in suspense, as I had misunderstood ideas and concepts. The sequence of concept, formation technique development and technique consolidation, based on real material and discussion and consolidation of the ideas developed, and application to new situations, were all absent. Constantly, the class lecture method was the order of the day, we all sat and stared at the 'brilliant Lecturer', delivering what 'seemed French', to us for as long as three-quarters of the lesson. We didn't have the chance to interact nor did we communicate with this great teacher of Mathematics. There was never a change in the classroom organisation.

In his book, (1982), 'Help your Child with New Mathematics' Claude Britwistle, has suggested:

> The changed classroom approach is perhaps best summed up by the term 'Child-Centred'. Such education puts emphasis on individual development of each child by assessing each child's needs determines the work that he or she does and the rate of working. Children may be working individually, or in groups, or as a whole class. It does not follow that one of these different types of class organisation - individual, group or class teaching - is always employed all time by a particular teacher. Usually a teacher will vary the methods according to circumstances so that all three methods are used accordingly at different times for best result.[11]

I don't remember at all, in the event of making an attempt to answer a question, being rewarded or praised by my Mathematics teacher, nor did I get any remarks in my mathematics class work exercise book, such as 'Good' or 'you've tried'. However, I did receive remarks like 'See me!', 'Stop being untidy', and 'be attentive so that you understand'.

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[10] Op it pg 48

[11] Britwistle, Claude.S, (1982), Help your Child with New Mathematics, Publishers Elliot Right Way Books, Kingswood Surrey U1L

I believe these frustrating and discouraging remarks, brought my hopes and moral so low that I became less confident. It is important, says Bruner, 'for children to be rewarded and motivated and to feel that their attempts or work is leading towards a goal. If children can correct their work in Mathematics; if an answer is right not because teacher says so but because <<< pattern confirms it, then they can begin to feel the sense of intrinsic satisfaction. Using pupil's answer and positive rewards plays a vital role in cultivating confidence'.

Whenever I got home from school with my homework, my parents did little or nothing to help me. This was because I hadn't then understood the language or the question asked and then neither could they. I was unable to relate to know methods plus I had failed to understand the Mathematics work. Often my parents found the new mathematics work confusing as well. It was strange to them as it involved modern maths.

> "The parents find the new work strange and the child anxious for help often finds the parents explanation different from what has been taught in school and possibly even crating more difficulties of understanding.[12]

Indeed, I had a fear of the subject 'Mathematics' for neither the Mathematics teacher nor my parents could help me out of my difficulties. My dislike for the subject was enhanced by the views of both my parents, that Mathematics was such a hard subject to grasp. They had developed a negative feeling towards the subject. My Dad often said, "anyway none of us in the family has ever been a Mathematician". This statement certainly explained my reasons for failing. However, research has shown that a child's attitude to Mathematics seems to be consolidated by the age of 11. Adults who say "I can't do Mathematics", are normally found to have formed this opinion by the age of eleven.

If you don't like something, you tend to avoid it and perhaps fear it. You form what is commonly called 'blockage' to it. If only my parents had kept any attitude to mathematics positive and inquisitive up to the age of eleven regardless of any ability, they could have prevented this blockage.

Sawyer (1964), says:

> "It is easiest to teach mathematics to very young children for they have inquiring minds and they are self reliant and want to understand things for themselves. A person who believes that only geniuses can learn mathematics will not learn the selfact. The proper thing for a parent to say is: I did badly at Mathematics, but I had a very bad teacher. I wish I had a good one.[13]

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[12] Op Cit page 7

[13] Sawyer, W.W. (1964), Vision in Elementary Mathematics, page 5.

A summation of all these experiences had both at school and home confirmed to me, the rhetoric used by many who are anti-mathematics that it was a hard subject, and it was against that background I formed a misconception about the subject and planned to keep away from it. It was my intention not to proceed with it in my future studies.

TRANSITION PERIOD

My Secondary and further education, saw me through a period of change, inevitably I had to venture into long, seemingly hard, Mathematics education. It required and demanded a lot of perseverance and encouragement from my teachers, to try and change my negative attitude towards the subject and hence understand it, followed by subsequent application to daily experience.

My teachers then used the 'Child-Centred approach', centred on the discovery method. During this period the individual differences were considered and determined for each learner, often we were in groups, involved in discussions and arriving at solutions through reasoning. The teacher was only a guide, to lead us to the desired goals. The classrooms were full of learning materials which we used in our free time, for example, pocket charts, flannelgraphs, place value charts and jigsaws. There was a lot of mathematical information displayed on the notice-boards as well. Whenever I made a contribution to a discussion, the teacher would supplement it with regard or praise, irrespective of the nature of the answer given. If I got a sum wrong, he would guide me into finding my own mistakes.

A lot of visual aids were utilised in the teaching. These made the once abstract subject real. The approach was from easy to hard, and concrete to abstract. I had never imagined myself the type of student I changed into a real lover of Mathematics, with determination to improve. My Mathematics class work exercise book had remarks like, "Keep up", "Well tried". Information about the nature of a good performance, knowledge of my own mistakes, and knowledge of successful results aided learning. The teacher was no longer the director of the classroom situation, proceeding along well-worn paths but was then the manager of an education enterprise. I must thank this type of innovative teacher who pulled me out of the misery of Mathematics. I developed confidence and had ambitions of exploring more of it, especially now that I could see its application to daily life.

Owing to the importance of Mathematics education, it is vital that the feelings, aspirations and moral of the learners are kept high, so that s/he can enjoy the application of the subject. Mathematics is in use in our everyday transactions, such as shopping, estimating, lengths, weights and so on.

Others study Mathematics for job security, in which case, they are subjected to utilising their Mathematical knowledge to earn a living. Accountants, and Cashiers are examples of such categories of people. Mathematics is important for technological work. One example is the mathematical theory of aerodynamics, where experimental workers have become great users of methods of statistical design and inference. During World War Two, the Science of Operation Research and the related systems analysis was established, using techniques of Linear Algebra, inequalities as well as statistical methods.

The subject also enhances future scientific discoveries to match the fast developing scientific world, for example, computers used in analysis. Maxwell's Mathematical analysis of electromagnetic theory in the 19th Century, and that of Hertz to demonstrate experimentally, generations later, the existence of electromagnetic propagation, sparked off the electrical industry. This industry made considerable use of mathematics, from Boolean Algebra to Algebraic Topology (for the analysis of network and circuits). Equally, Mathematics always plays a paramount role in Commerce and Industry matters.

"Practitioners as Researchers Conducting Research Where the Rubber Meets the Road", Safford, K. (1997). There is a lot of truth here, for adult mathematics educators. I feel very strongly that, the subject, is of importance to adults and I believe others can feel the same. However, the most important process is that involving teaching and learning of mathematics. If this process is not handled properly, then the results will be unfavourable to the adult learner of Mathematics but if handled properly, then the adult learner has the chances to explore and manipulate the subject. The latter is my goal and I think we should engage many people into the discipline.

Adult student 'WA' comes from Sierra Leone in West Africa (see Fig ROA/2), who has taught Mathematics for almost fourteen (14) years at both secondary level, and also participated at various Mathematics workshops for primary school teachers. He had positive attitude towards Mathematics education and he is looking forward to getting a degree in Mathematics and Computing Sciences after the completion of the Mathematics Foundations Course. In addition, he has a sound mathematical background through the rather "old" method of learning Mathematics.

> The Mathematics Foundations Course is the ideal course for recent school leavers and adults like me who are interested in updating our skills in Mathematics. By devotion, time and interest for just one year, you can achieve a level of Mathematics to GCSE and A level standard. After completing this course with no doubt you will be so motivated that one will be more than anxious to continue to a higher level Mathematics. I have done this course during 1990-1991 and at present I am doing a four year extension degree in Mathematics. Thanks to the Mathematics Foundations Course Team". (Ga 1993).

We travelled from West Africa to South America to meet with adult student GA from Guyana. GA was a former student of the Mathematics Foundations Course and who has successfully completed his BSc (Hons) Mathematics and Computer Science degree in 1997. Yet, another adult student from Guyana, interestingly enough recalled her "school days" and do believe in the old saying, 'Learning is better than silver and gold'.

Adult students DOP, Weston and Keithly come from the United Kingdom. They share a fairly uniform experience of Mathematical education in the British education system. Some have argued that the system of state education in many circumstances actually reinforces inequalities already existing, rather than to overcome them. Yet others like Denis Lawton (1975), has expressed the view that, although England is a democratic society, and highly industrialised, but her education policies and practices are failing the children. Thus, it can be argued that the education system often ignores good scholars, due to the fact that the state selectors have focused their attention on the social status of the family and environmental influence, depending on how long a child remained at school, how well he/she did depended on the social class - occupation of the father, and also the social class and occupation of the immediate grandparents, and their origins.

ADULT STUDENT WA

Mathematics is a subject that deals with the Science of the "living". This statement can be true because Mathematics weals with many other subjects like 'Pure and Applied Sciences', Social Science, Astronomy, Medicine, Business Studies and the like. It is a well known fact that Mathematics started as a result of the fact that when the early traders wished to invent methods of recounting their sales and make records of how much of their merchandise had been sold.

HISTORY

History tells us the difficulties that were being encountered in pursuit of "inventing" numerals to meet their challenging tasks. Certainly, one of these tasks is the 'Balance of Trade', at the times were not accurately recorded. History also tells us how the various numerals, such as the Egyptian, Babylonian, and Roman numerals were introduced amongst the so-called merchants, and more so of the difficulties that were encountered when complex arithmetical computations were faced with, yet more efforts were made to innovate a very appropriate numeral set of symbols to fulfil their objectives.

On this same vain, Mathematicians owe immense credibility to the Hindi-Arabic people at such times for the invention, introduction and implementation of their Numeral symbols that are in current used today (0-9). It is, however, to be recalled that due to further research and experimentation, other numerals and symbols have been founded which benefit our present day generations and for future advanced scientific and technological pursuits.

MATHEMATICS

Mathematics is a "growing" field of study, like a baby being born into the world and is to let grow up, until he or she reaches maturity, but yet all the more, the adult student continues to learn up to his or her death. On these notes, I wish to endorse the comments made by the author WW Sawyer (1995), in his book "Prelude to Mathematics". The author's interesting and valuable points helped me personally to ascertain my ingenuity about the "advent" of Mathematics.

WHERE HAVE I BEEN

During my early days at Primary School in my home country, Sierra Leone in West Africa (see Fig ROA/2), the teaching of Mathematics, I would say, was a bit "crude", in terms of method of approach, teaching of the subject, understanding and application of the various topics taught at school. Emphasis then was laid upon how much one can reproduce mentally, rather than enforcing the idea of investigations, decision-making, and formulating conclusions based on experimentation.

I would recall this point as to when I was taught the formula for the area of a square, as compared to the "method of discovery", known as the method of Tessellation. I have been through a rough path, but my saviour then was the natural love of the subject, and more over, the natural ability and flair in it.

Under these pretexts and discipline, I acquired a good mathematical background up to the end of my Primary School.

WHERE I AM GOING

I pressed on towards the mark, aiming to let Mathematics be my watch-word. I went through my junior education, studying amongst other subjects, Mathematics, Additional Mathematics and other subjects of interest. On this basis of Mathematical knowledge, I opted for science option at my senior year of my Secondary education, studying subjects like: Physics, Chemistry, Mathematics and additional Mathematics. The same methodology of learning and mastering mathematical skills continued only with some flexibility, being introduced to more abstract topics, such as probability, statistics, applied Mathematics such as kinetics, kimatics, dynematics and statics. Under these various branches, I came to realise a better appreciation in the study of Mathematics, getting the awareness of such topics about "Chances" in life, that is to say, negative and positive probabilities, permutations and combinations for various choices and other social aspects involving other areas of Mathematics. I, therefore, look forward to getting my degree in Mathematics and Computing Science in the near future.

WHERE I AM NOW

Up till now, I have acquired a sound mathematical background through the rather "old" or crude method of learning, for example, reciting times tables by heart or through memory, memorising basic formulae for the use of Mathematics computations and for examinations. Nonetheless, I must confess, I think I take much longer time and efforts for these Mathematical facts to tick on to my brain.

On the contrary, I would think that if at my time of learning these rudiments, use the modern methods of learning mathematical principles such as the use of audio visual aids, mathematical models, etc, I would say that these modern techniques would have made me to assimilate and grasp the rudiments much quicker, for it is known that Mathematics is a tool for the exploration of other studies.

Having studied Mathematics to this advanced GCE level and even beyond I feel I can make myself adaptable to accept the new techniques such as using computers to help build up my background even better.

MY ATTITUDE TO MATHEMATICS EDUCATION

My attitude to Mathematics education is one of a positive approach, I have shown over the years of my learning Mathematics, a determined and challenging spirit in this venture. Moreover, I have taught Mathematics for almost fourteen (14) years at both, Secondary level, and also participated at various Mathematics workshops for Primary School teachers in my country, Sierra Leone.

During these times, I have myself being able to see the many varied reasons why many people in the world today do not wish to continue to learn Mathematics. However, I must say, I personally tried to develop attractive skills to help motivate their interests. By this, I mean, I used to implement musical acoustics such as teaching the mathematical principles with the aid of "music singing". My experience on this method proved very profitable, because knowing that children like songs, and like singing, I then tried to incorporate the Mathematics ideas (some), in the form of songs in a bid for them to be able to remember at all times these Mathematical facts.

As I said earlier that Mathematics is a "growing" subject for the living, it is, therefore, to be realised that without the slightest understanding of basic arithmetic, could make anyone's life very miserable, because he or she cannot even know whether his or her wages after being handed over is correct or wrong.

It can be argued that it is a basic fact of life that even a child of 2½ (two and a half years old), or 3 years will begin to give the answer of such simple arithmetic questions as one add one equals two. We know, of course, that counting by the hand is the most fundamental tool in working out basic simple arithmetical problems.

The modern world today needs a sound knowledge of Mathematics to cope with the technological advancements in industries, hospitals, in the home and various other sectors of life. Certainly, the introduction of the "Teaching of Probability in School", (Angiama, RO, 1981), could be very challenging and inspiring for at such an early age of learning Mathematics a positive result at such a stage could no doubt give a good way ahead as one approaches to the higher levels of learning Mathematics, hence such views in support of the "Teaching of Probability in Schools, Colleges, and Higher Education", will suffice in this pursuit.

All in all, it will be worthwhile to mention that some people, however, tend to understand the basic principles of Mathematics as they grow older, thereby establishing the fact that Mathematics is a growing disciplined subject. On the contrary, it could be argued there are those people who have a very high IQ who could easily grasp the fundamental ideas of Mathematics at a much earlier age.

ADULT STUDENT GA

It was fun, just playing moving beads along a frame with several rows, each of different colours. The beads on each row could be moved from one end to the other. I enjoyed re-arranging them. Not knowing that I was being introduced to Mathematics at the early age of five, when I started to attend Primary School. With this teaching aid I received some of my first lessons in counting, adding and subtracting. Arithmetic (and I can't remember hearing of Mathematics during that time) remained my favourite subject until about my eighth year in Primary School when Algebra and Geometry were drafted into the curriculum.

From the inception, they captured my interest. There was no more time to spend reading comics and novels. Instead I devoted my time to reading Mathematics texts and working on problems from the given exercises. Each new chapter was related to, or demands a knowledge of, those previously covered. Algebra was the most trilling of the three. One particular problem concerning a 'simple equation', took me over a week to solve. I was determined to find, without help from anyone, including my teacher, a logical solution to this simply worded problem that was teasing my brain. Then suddenly, one day while running it

through my mind, I became aware of the fact that if you are X years older than I, the difference between our ages is the same whether past, present or future. Hall, H.S. (1987), in his book, 'A School Algebra', gave me this one to remember. The problem reads, 'Mary is twenty-four; Ann was half the age Mary is, when Mary was the age Ann is now. How old is Ann? (Miscellaneous Example iv, exercise for revision D NQ 28). This was during my Secondary School days.

Shortly after the introduction of Algebra and Geometry to Primary Schools in Guyana, I entered Secondary School and was always first in Mathematics tests during the years that I spent there. At the College of Preceptors Examinations I obtained a distinction in Arithmetic, Algebra and Geometry and a 'B' grade in Mathematics at the GCE 'O' level exam. Unfortunately, due to circumstances, I was forced to abandon my studies for the 'A' level examination and seek employment. I became a teacher. I entered Teacher Training College - Secondary, where my main option was Mathematics, and remained in the profession for twenty-one years.

The knowledge that I have acquired even though I was a teacher, there was never the opportunity for me to utilise it or apply such skills in any tangible way. It has been dormant for several years. The opportunity for furthering my studies now presents itself again. This 'Mathematics Foundation Course' and the Certificate Course which I hope to start later in the year should serve as a reviver to awaken those areas of mathematical knowledge that have been asleep for so long. After the completion of these two course, it is my desire to embark on a four year part-time study for a BSc (Hons) degree in Mathematics with Computer Science.

Man has been blessed with the ability to think and to reason. To my mind there is no other subject area that aids so much in the development of this ability like the study of Mathematics. Solving mathematical problems demands this. Arriving at decision faced with in every-day activities whether at work or elsewhere demands a proper usage of this ability. In our different societies today, we find so many, especially within the younger generation lacking this ability. It is my opinion that our attitude to Mathematics education is a major contributory factor to this situation.

Mathematics education has changed rapidly over the past four decades or so. New methods have replaced traditional ones. An old proverb says 'Bend the tree while it is young'. We are also told that physical exercise keeps the body in good shape. For the brain to function in the way we desire it must have the right exercise too, especially in its early development. The question can be asked, is our approach to Mathematics Education providing our youth with the exercise that the brain needs? We

take things for granted. One simple example is no longer do we teach multiplication tables. They will supposedly learn these as time progresses. This might be true but the learning process will take much longer. This is true for many of our children who are leaving school not knowing how to 'multiply and divide' thanks to the calculator. I am not advocating a return to traditional methods, but many things that we are not teaching today, would be reintroduced to our school children. 'Modern Mathematics', what an interesting term. Let us remember this, that our present achievements stemmed from our knowledge in the past. Let us all too, think about it and join our hearts and hands to improve our present standard of Mathematics Education.

"SCHOOL-DAYS"

As far as I can recall, I attended kindergarten school at 3 years of age for two years until I was age 5. My mother always accompanied me to School.

In the first year, I mainly played games and listened to the teacher telling interesting stories. In my second year, I was taught the alphabets from a colourful (big) card which was always known as the ABC card. This card had a picture besides each letter indicating what the letter meant, which enabled one to learn the twenty-six letters of the alphabet easily. I was also taught the basics of reading and writing simple words and was also given an "abacus frame" to learn the art of counting and writing numbers down in my mathematics "workbook". In the beginning, I could write numbers from 1-20. The teacher also taught me to recite and sing nursery rhymes.

Sadly, the two years had ended quickly and it was now time for me to move on to Primary school at age 5 years. On my last day at "kindergarten", the teacher gave a short speech of Primary school Life. We all knew we would miss each other's company and the warmth and friendliness of the teacher, as we went our separate ways to various primary schools.

When I started primary school, my first year teacher was pleased with the knowledge I brought from "kindergarten". I was also being helped by my mother as she read me interesting stories which gave me a good start in my education.

The hours were longer at primary school, from 8.30 am to 3.00pm. Monday to Friday. There were seven classes at this school and also an extra one for the pupils who were capable of taking the 11-plus examination. (This class was known as the Scholarship class). The successful 11-plus students went on to grammar school just before their 12th Birthday. The other students were expected to remain at primary school until 14 years of age.

Each class was very interesting. We were taught various subjects, which included: reading, writing, spelling, English, composition and "grammar", literature, drawing, hygiene (laws of health), arithmetic, singing, reciting and games. We were always encouraged to visit the library and also read widely.

At the end of each school year we sat an examination to be promoted to a higher class. I was indeed always fortunate to be promoted each year.

There was also a "guiding group" at this primary school of which I became a member and one of my teachers was the Guide Captain. This extra activity led to a lot of interesting experiences. There were outings with long hikes, weekly meetings, camping with camp-fires and parades. We also had to take part in various projects to obtain badges and became recognised guides. Guiding days are unforgettable ones which bring back fond memories.

At 13 years of age, I left primary school to continue my education at secondary school. A quarterly fee was charged for secondary education. At this stage the studies were beginning to become more difficult as the curriculum now included science subjects and a foreign language. There were frequent visits to the library which I always enjoyed. I was able to study in the "quiet room" and borrow few books on each occasion to assist me with my studies.

To conclude, as an adult student living in England from Guyana, I had the opportunity of attending evening classes and was able to gain two GCE 'O' level certificates in English Language and English Literature. I did enjoy all of my "school days" and do believe in the old saying, "Learning is better than silver and gold".

ADULT STUDENT DOP

My schooling took place in the late 1940s and early 1950s. It was a time when the emphasis in schooling was on how many children a particular school could get through the 11 plus examination each year, rather than on providing an education.

The state primary school which I attended and the junior school were all in one building and, although separate, were basically one school. The school was near Blackheath so there was a mixture of children from different social backgrounds. There were those who came from the well-to-do middle class families who lived around the edge of the Heath and those from the industrial working class living by the River Thames.

It soon became apparent that the middle class children were advantaged. These children had access to books and professional know-how at home and their parents knew how to handle the teachers and the education system. Thus their children came to be placed in the higher forms where the occupants were expected to pass the 11+ and so obtain a grammar school place. The better teachers in the school were assigned to these forms. As for the remainder of the children, the object seemed to be to teach the very basic necessities with the resources left over, for example, they were taught by the mediocre and poor performing staff, and asked to do such things as making puppets. This could be quite entertaining but absolutely no use in passing the 11+ examination. Consequently a very high percentage of the working class children, of which I was one, were sent to comprehensive schools.

The comprehensive school was worse. From a mathematical point of view, it did not build on the basic addition, subtraction, multiplication, and division principles which the education system had spent five long years going over and over, boring the working class children to tears because the teaching staff did not want to teach them. The better teachers always wanted to teach the middle class, potential grammar school children as the prestige involved was good for their careers, and their motivation. Those teachers seem to feel that they were just as much failures as the children. For example, they were teaching in comprehensive schools because they had failed to gain a post in a Grammar school. Subjects like physics, science and Latin were not taught at all.

An enormous amount of time was wasted, whole afternoons were spent sewing three buttons on or ironing a handkerchief when the time should have been spent building on the basic arithmetical operations learnt in primary school. The only mathematics I learnt in secondary school was how to use those basic operations when using letters instead of numbers but no explanation was ever given or examples shown as to how this should be used in practice. The same applied to geometry, the basics were presented but that is all. This seemed to be the case because girls would, it was said, not need mathematics for engineering and such subjects, and it was unlikely that any girls from a secondary school would be able to teach it as they would in any case lack the necessary ability. Added to that, the shortage of mathematics teachers usually ensured that they secured grammar school posts, with teachers in the secondary schools undertaking the teaching of mathematics on a part-time basis to their own subject.

I had enjoyed mathematics in primary school but had become frustrated because of my lack of progress. My working class background meant that I was destined for a secondary school, so

continuing the inferior education I was given. I enjoyed details and found this temperament helpful in mathematics work. Whether I have an aptitude for it or not I have not done enough mathematical course work to find out, but I am hopeful because in 1982 I passed an accountancy examination at the first attempt. However, I realise that accountancy is different from mathematical calculations. But this has boosted my self-confidence slightly and made me hopeful of conquering mathematical subjects.

I was the only child of working class parents who both worked and I was looked after during the day by my deaf grandmother, so there was little chance of conversation. There were no books around the home as my parents had little time to read. So I became used to spending time on my own with puzzles, which I enjoyed.

After leaving school without any mathematical qualifications whatsoever, I tried evening classes, as I still had a desire to understand mathematics. However, these classes always seemed to assume that all that was needed was revision, whereas what was needed was a re-learning of the whole subject. It is no good revising what you do not know already.

This is how I have become completely disillusioned with the mathematical and education system. I feel there must be some way to learn mathematics. So much depends on luck in education. If one can find a good teacher at the right time and who can simplify the subject enough without making it boring, mathematics can become easy. But many teachers are not prepared to, as they see it, waste time on detailed explanation to individual class members.

In conclusion, I would say ultimately that this may be aiming rather high as I still need to find out my potential in this area. When I saw the 'Foundation Course in Mathematics', advertised at Goldsmith' College, this seemed to be the answer to my getting the thorough grounding in the subject that I need to fulfil this ambition. My view is that it will be just another rapid revision course and not take into account that most of the concepts are entirely new to me and need explanation in detail so that I may obtain a through understanding.

ADULT STUDENT WESTON

In this paper I have given two accounts, the first is a subjective rendering of my mathematics education to date, the second explore briefly some attitudes towards mathematics education.

The route that has led me to the present, to the classroom of the "Mathematics Foundation Course" has been an almost circuitous journey, from my early primary school days to this adult education class I have encountered mathematics at every step and it is only now that I feel I have the key to the knowledge sought after.

Starting school was a huge adventure, suddenly I found myself surrounded by all sorts of exciting things designed to stimulate and 'educate' me. It was at this early age that I discovered a love of reading, I would be transported by tales of misplaced princesses, human frogs and impossibly happy endings. I was also very creative and was often found with a crayon or paintbrush happily scribbling away. My recollections of mathematics as part of the time-table at this early age are, it must be said, a bit vague and hazy, but I do recall a certain amount of 'rote' learning which consisted of reciting times-tables in unison with my peers, and such group activities as transforming bits of coloured paper into two dimensional shapes which resembled objects from the 'real' world.

Mathematics at this time was integrated into school life much the same as other subjects, it was not perceived as a difficult subject but it did not appear to be that significant either.

Middle-school soon followed, in the lower years I found myself keeping up with mathematics to a certain extent. Mathematics seem to involve filling in a series of question and answer type booklets and this posed no problem, I was conscientious student and enjoyed completing each new assignment. However, I did encounter a problem in the latter part of my middle-school years, suddenly at the age of twelve we were 'streamed' according to our ability, or so I was led to believe. It was only later that I discovered we were allocated to different groups due to the ability of our elder siblings! where this was appropriate of course. As my sister had proved herself to be mathematically capable so I was destined to follow in her footsteps. Unfortunately this system did not appear to work for me, I found myself part of a large rowdy group. Whether it was the group or the subject, I nonetheless found myself 'switching off' and longing to be elsewhere. The teacher was uninspiring and mainly taught the subject visually using the blackboard to demonstrate the steps required to solve problems, followed by

copious homework to be completed for the next lesson. I was experiencing difficulties, and had problems trying to grasp all the new information given so speedily in class. I decided to take matters into my own hands and requested to be moved to a lower stream, I was offered no resistance, the teacher had one less pupil to get through the 'O-level' examination and I was able to concentrate on the subjects I enjoyed most - the 'Arts'.

School life hurried on. I was now at a large mixed comprehensive school in Sussex, the arts and sport featured largely both in and out of school time. I was never happier than when absorbed in the library, the art room or the school field. Mathematics was definitely relegated to last on my list of interests. After yet more uninspiring maths lessons and practically no revision, it came as no surprise to learn of an ungraded 'CSE'. I was ready to abandon the subject altogether but once in the sixth-form I was told it was a pre-requisite I obtained a qualification in mathematics, and so I dutifully enrolled for the 'CEE' course. To my surprise I enjoyed the classes, the work was relevant to everyday life and coursework was introduced for the first time. I emerged from school with a grade five, a result I was not displeased with considering my disastrous CSE one.

After school I left home and trained as a general nurse, although an 'O'-level in mathematics was not an academic requirement a thorough working knowledge was, so I worked extra hard to cope with the calculations needed. I was successful and qualified as a staff nurse.

After practising as a staff nurse for some years I decided to pursue my interests in the arts and return to full time study. I graduated last year with an upper second in English/Art and applied for a place on the PGCE course, however I did not have the necessary mathematics qualification and was offered a place providing I obtained a grade 'C' or an equivalent, acceptable qualification. I enrolled on the GCSE general level mathematics evening course at Lewisham College, this leaving me free to work during the day. I enjoyed the course and met other graduates in a similar position as myself. I studied hard and discovered a new found interest in the type of mathematics being taught in our schools today. Unfortunately I obtained a grade 'D',. Slightly disheartened, I reluctantly enrolled again at Lewisham College but I had to find inspiration somewhere if I was to progress,. Luckily for me help came in the form of the "Mathematics Foundation Course", and it is here that my quest for a useful and relevant mathematical education culminates, for the moment anyway!

So far I have tried to explore my own personal attitude to mathematics. I shall now take a broader overview.

The children in our schools today are growing up in an age rapidly being altered by science and technology. Keeping pace with these accelerated advances and being unaware of what the future will expect of these children makes the task of the teacher and those who produce the theories to guide him more exciting and challenging than every before. It is essential that these children should have some understanding in mathematics and its allied subjects in order to cope with modern living and realise that most of the scientific advances are based on simple concepts that they can comprehend.

Modern requirements have had an effect in the junior and infant stages and a less formal approach, partly created by a rich and stimulating school environment, already partially exists.

The secondary schools have been slower to change their traditional methods. It was often the case that the majority of school leavers either hated maths or were convinced that they would never understand the subject. However, with the new style GCSE mathematics syllabus well established with its mathematical problems based firmly in the modern world, we may see in future a new generation of more mathematically aware and numerate teenagers. This is probably not the case just yet as Elaine Williams notes in 'The Independent': "Behind the bright demeanour of our cleverest graduate and undergraduate students lie some fearfully innumerate individuals."

An enthusiasm for mathematics has to be nurtured as early as possible in life if one is to progress with the subject, and the way it is taught in our primary schools today is crucial. The learning of maths so often appears split up into a sequence of well ordered steps rather than individual topics. Topics may be the answer for some children because learning often occurs in wholes. After plodding on and on in despair one suddenly understands and the solution 'clicks' and falls into place. Such learning is memorable and transferable to new situations.

If a cognitive reasoning is applied to the study of mathematics and new ways are found in which learning can take place with greater insight, laying less emphasis on rote learning, one may generate an interest in the subject early on.

It may be appropriate to consider one of Piage's (1896-1980) theories here: his theory of the growth of intelligence in children gives the intended 'solver of problems' the stages which children go through in cognitive development. His theory would suggest that each state must

be completed before it blends into the next state. Thus if any child is introduced too soon to any kind of activity he will probably become confused and develop a distaste for this activity. This idea is particularly applicable to the teaching of mathematics where practice of sums has largely been used in lieu of activities leading to concept formation.

This theory would tend to be confirmed by the work of Galparin & Talyziny (1961) in Russia who used the same methods to teach normal children and children with profound learning difficulties aged fifteen to sixteen. All the pupils were engaged in activities with concrete materials and each step, initially, in forming a concept was worked through audibly. Subsequent learning revealed that the same steps could be omitted due to the children beginning to think orally and mentally. It was possible to gradually reduce the concrete aids and the older children tackled faultlessly geometry that had previously proved impossible.

A mathematics club is an exciting idea open to the mathematician as it provides the opportunity for maths to be enjoyed as recreation, for the exchange of ideas, the study of new topics and extension of interest. So much material can be drawn from science, mechanics, geography and astronomy. Spatial knowledge and an aesthetic and rhythmic satisfaction can be gained from hand work resulting in patterns, plans, models, loci, scale drawing and surveying.

A maths laboratory would seem an excellent idea and using inexpensive everyday equipment many interesting experiments could be developed to give new meaning to mathematical results and processes, for example, gyroscopes, the construction of 3-dimensional shapes and new ways found to represent statistical data. Above all maths would be fun!

Unfortunately maths in the past has all too often been taught as a training for the all too important examination, but at the end of the day both teacher and pupil must face the question, whether satisfying the examiner was enough? Unless one is encouraged to approach the subject in new and dynamic ways, which are both relevant and useful to the individual, unfortunately mathematics will never be properly appreciated.

ADULT STUDENT KEITHLY

My early years were spent in one of the overspill suburbs of Liverpool, which in later years came to be seen as a disastrous social experiment. I often wonder how my parents would have viewed the prospect in the early fifties, of moving from their poor but comfortably familiar inner-city environment, to that new and unfamiliar place.

I suspect they naively accepted things in the spirit that this was a starting point and amenities would be added, and a community created. It was in this atmosphere my primary school days began, and like most people, I have only happy recollections of kind and attentive teachers and friends. I was not bright, and must admit to a feeling of kinship when I read of a French child in an education survey who was asked, "You have ten red pencils in your right hand pocket and ten blue in your left, how old are you?" "Twenty" came the reply. When informed that this was the wrong answer, the child (quite logically in my opinion) informed the questioner he hadn't been given the right numbers.

In that fable is an element of my early feelings towards mathematics, I would struggle to give answers to set problems, without them bearing much relation to what was asked.

My secondary school days began in the early sixties, and having failed the eleven plus examination, went to what was known as the local "secondary modern". By now I could sense my family's disillusionment with their allocated home, and my new school offered a daunting challenge as my teachers seemed stern, and some of my school mates physically intimidating. In common with my peers I was again not academically inclined and if you had met me at that time I would no doubt have been humming the latest from the Beatles or the Stones whilst reliving the exploits of my soccer heroes.

Still I would have not been regarded as the lowest achiever, and my meagre haul of four 'O' levels would have augmented had it not been for an event that took place in my third year - my school was converted to a comprehensive school.

I had found a quote that says "The seeds of dislike of mathematical thinking... is sown by the anxiety of school teachers to meet externally imposed criteria of selection tests". How much of that statement applies to my personal experience I am not sure, but the introduction of the comprehensive school brought with it a much greater anxiety, the presence of girls! Previously the girl's school was sited opposite mine, and we would view them innocently as

mystical objects of desire, because without doubt, we were less sophisticated and more inhibited in the presence of the opposite sex, than adolescents of today. So a crucial period of my school days was spent more in a haze of self-conscious posturing, than reading and studying. I left with a Grade 1 CSE in maths and the aforementioned 'O' levels.

The year is now 1968 and amazing as it might seem to a young person reading this account today, despite my moderate performance at school, I still had career choices. This was in the middle of a long period of socialist governments, and whilst I have referred to what I would consider one of their main policy failures, ie a profligate and wasteful housing policy, the other side of the coin was the fulfilled expectation of full employment. I could have had several jobs, but in the end it boiled down to two. I passed an examination, which offered me a choice of an apprenticeship in the printing industry, and the second was an offer to become a trainee medical laboratory technician. All my uncles sagely encouraged me to go for the former as the printing industry was regarded as solid and well paid. As luck would have it I had a good friend already working in the University Medical School, and I chose that because I enjoyed his company, and against better advice as this option was traditionally low paid. The conclusion to that debate came over a decade later when I sat and watched the riots of the print workers as the new technology took their employers to Wapping, and many of them onto the dole queue.

By then the political pendulum had swung to the right, and the propaganda machine had enabled the welfare state to begin to be dismantled. This had disastrous consequences for the site of my school days. One of the most notorious ways that the present government invoked these changes was their appeal to the better off and their prejudice that poverty was deserved, and social welfare only encouraged malingering. "Basic statistics dramatically illustrate that contrary to stereotypes about laziness and scrounging, people do want jobs". Perhaps here is a hint at my new found interest in maths.

However I have digressed, my first job choice in 1968 was a fortunate one for me. I proved to have an aptitude for this technical work and I passed my examinations after 3 years' day release study, muddling through the maths, for my HNC. In 1976 I left my job to work for three years in Africa, Zambia to be precise. I again worked in the Medical School in Lusaka, and the experience was an important time in my life, educating me in a way formal studies could not. Mine was not the introverted experience of many ex-patriots abroad, but living and working on a University campus, and my first real experience of multi-ethnic society.

After three years I had the opportunity to renew my contract and I was so at ease with the style and the pace of life, my whole inclination was to do so. However something was telling me I would have to eventually come home and the Rhodesian war was looking like encroaching into Zambia, so I returned.

Of course it was a shock in 1980 to find employment chances much reduce, and like many of my counterparts in the North of England, I had to come to London to find work. I was lucky enough to get a job at Guy's Hospital, in the electron microscope laboratory. This work I found interesting and so I registered for a diploma in that area of science at the South Bank Polytechnic, which was a two year day release course. Part of this entailed advanced physics, which to some extent was a mystery to me. As it happened I passed the exams as top of my year but some of the maths associated with it remain a mystery to me. In recent years I have continued to work at Guys, and as time has passed the work and the people it brings me into contact with mean more to me.

I am now co-author of scientific papers on subjects such as X-ray analysis in relation to histopathology. Needles to say I feel a fraud, as I don" think I am basically numerate. However, on investigation I find I am not unique. "Problems with numbers are not confined to non-scientists, eg a technology assessment study was conducted by a prestigious team headed by a senior PhD. The conclusions were in error by six orders of magnitude, ie they had neglected a factor of 1,000,000 at the head of one column".[14] In a recent article, in the Independent newspaper (23.7.93) by Elaine Williams, the extent of deficiency in numeracy skills in students and graduates of Institutes of Higher Education was stated to be widespread. So perhaps the moral is I am in good company.

My present situation is I am happily employed at a hospital whose future is under threat. I refuse to view the future purely with trepidation however. I am lucky to be married to someone who is supportive and sees life in terms other than in material values. I see my presence on the Mathematics Foundation course, as a statement of intent to meet the future with the intellectual ammunition needed for a positive approach to the challenges ahead.

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[14]The Independent Newspaper (1993) Elain Williams

COMPARATIVE EVIDENCE

It is frequently argued that Comparative Studies are an effective alternative to experimental testing. Clearly they offer some possibility of non-experimental empirical testing. How precisely they can be used in conjunction with the problems of adults learning Mathematics and hypothetical deductive approaches remains a central issue, towards a solution to which this research is directed.

There is, of course, a world of difference as to the methods of approach being utilised in such countries as the UK, USA, USSR, etc as compared to the method of teaching Mathematics being used in the economically developing countries like Africa and the Middle East. It is a fundamental idea that the same true mathematical principles are correct everywhere but the teaching methodology of delivery makes a difference, which of course, can create better performance and good results because of the use of modern technology.

MAJOR PHILOSOPHICAL POSITIONS

Curriculum theory is usually a constituent either explicit or derived from a major philosophical position which includes theories about the nature of man, knowledge and society. Logically, it frequently appears most closely connected with epistemologies but generally it has to be defined (or justified) in logic or in practice by reference to psychological and social theories.

In conclusion, for the purpose of comparing (analysing), the paper concludes, by selecting three major critical mathematical curriculum theories which have some bearing on the selection of content and how it is taught. I characterise these contexts as 'essentialism, encyclopedism and pragmatism' to include the general position in order to identify constituent curriculum theory for Adults Learning Mathematics (ALM).

ESSENTIALISM

The curriculum theory associated with this position suggests that a sound general (liberal) education can be provided adult-focused curriculum based upon a small number of "essential" subjects. The identification and selection subjects for inclusion in the curriculum are justified philosophically. These should take many forms - relating to the goals and values of the learners, take account of their experience and diverse purposes in learning Mathematics, including work-related Mathematics; education for critical citizenship and social movements, providing a negotiated curriculum. Mathematics support for other subjects should start with, rather than end with the subject concerned (Diana Coben, ALM 1997).

Associated historically with such theories are about ("rational nature of man and women, my emphasis"), which distinguishes him or her from other animals, and political theories about the participation of individuals in the running of society. In both the political and psychological theories there is more than a suggestion that not all men and women are equally rational or indeed able to participate in a political democracy.

In present day discussions, it is useful in 'Comparative Studies' to recognise not only the extent to which theory is conducted within a framework of essentialism but also the extent to which historically associated political, psychological theories have been overtly or covertly abandoned. For example, among current writers who overtly reject elitism some search for, or accept, psychological theories which justify for a mass school audience the retention of a curriculum based upon "essential" subjects.

ENCYCLOPEDISM

I argue for a critical curriculum for adults learning Mathematics. The curriculum theory associated with this position suggests that a sound general (liberal) education should include knowledge so that an adult-focused curricula should be broad. Associated historically with this position are theories about the "potential reasonableness of all men and women", some of whom constitute an "aristocracy of talents". Political theories about democratic government and theories about the relative merits of the natural sciences compared with classical languages in the light of socio-economic change. The aims of education as expressed by some writers, are to ensure that all members of a society know their civic rights and understand how to perform their civic duties; and that a few, the aristocracy of talent should be educated to offer leadership in a democratic society.

PRAGMATISM

The curriculum theory associated with this position (see Brian Holmes [1974-1975 p142-144]), rejects as it point of departure a view implicit in essentialism and encyclopedism that there is such a thing as knowledge which given the appropriate tools of analysis can be conveniently divided up into "subjects". It starts from the premise that the content of education ought to be organised in the light of the problems, now and in the future, adult students face. Associated historically with this position are psychological theories about human intelligence, individual and collective, reflective thinking processes in problem solving, and political theories about democratic societies.

The aims of education in pragmatism stress individual development and adjustment (adult centred) and the reconstruction of society through educational theory (society centred wing). Finally, ALM Chair Diana Coben (ALM 1997), has challenged us and I share with her when she said: "More research is vital to increase our understanding and enhance the status of adult mathematics education. Developing and using appropriate adult-focused research methods is essential to develop the field. Co-operative research, between researchers and practitioners to identify agendas and, where appropriate, to undertake research. More research is needed on all aspects of adult mathematics learning and teaching, developing new areas and building on previous work in adult mathematics education, mathematics education for children, related disciplines: eg psychology, sociology, etc, and mathematics per se'.

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